Aging Systems Task Force
Aging Transport Systems
Task 1 and Task 2
Final Report

August 1, 2000

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(List of Members attached)

Executive Summary

This report provides the results of three separate tasks assigned to the Aging Systems Task Force by the FAA-sanctioned Aging Transport Systems Rulemaking Advisory Committee. The three tasks were to survey the airplane wiring installed on representative examples of aging DC-8, DC-9, DC-10, 727, 737, 747, L-1011 and A300 airplanes, review service documents currently available to the fleet for possible additional action, and review existing airworthiness directives which mandate periodic, repetitive inspections for possible terminating action.

The document is arranged into three parts corresponding to these three tasks, with additional information and data contained in the attached appendices. A summary of each task follows:

Part I – The non-intrusive wiring survey of 81 airplanes identified 3372 individual discrepancies with the condition or installation of the airplane wiring, 182 of which were deemed significant to require additional review for possible corrective action. Five noted discrepancies may result in changes to the in-service fleet. Also resulting from the survey are recommendations aimed at enhancing present maintenance and inspection practices.

Part II – Detailed review of 714 service documents related to airplane wiring resulted in a total of 51 documents that may receive some additional emphasis for incorporation, ranging from encouraging incorporation to prevent conditions noted during the airplane survey to eventual mandatory incorporation via regulatory action.

Part III – Review of 79 airworthiness directives containing repetitive inspections with or without a modification terminating the inspections resulted in the recommendation that eight be considered for mandated terminating action.

This report and the accompanying appendices form the final report from the ASTF to the ATSRAC and concluding action to Tasks 1.4, 2.2 and 2.3.

Randy Pope
ASTF Chairman

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Appendix C	Included additional process details and results	
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Record of Revisions

24 July 2000

Executive Summary	Updated total significant items and service documents reviewed based on new information	
Part I – Non-Intrusive Survey	Revised titles of categories Revised Recommendation 1	Pg 6 Pg 9
Part II – Service Data Review	Revised Recommendation 1	
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Background

The Aging Systems Task Force (ASTF) was formed in July 1998 by the Air Transport Association at the suggestion of the FAA. The purposes were to:

- define and document airline best practices with regard to aging systems
- prepare and implement a specialized sample inspection, by aircraft type, of aircraft systems wiring on airplane models with type certificates over 20 years old
  - collect and analyze the inspection findings
  - evaluate the data and devise an action plan if and as indicated by those findings
- Initiate longer term program revisions to better prepare for potential problems with aging wiring

The release of the FAA Aging Transport Non-Structural Systems Plan in October 1998 and the formation of the Aging Transport Systems Rulemaking Advisory Committee in January, 1999 resulted in the ASTF being requested by the ATSRAC to undertake these additional tasks:

- establish the criteria for selection of service data and then review service data and service experience
- review existing regulatory actions with repetitive inspections to determine if terminating action is appropriate

The ASTF is comprised of representatives from North American airlines, the FAA, the ATA, aircraft manufacturers, DoD organizations and other industry associations. The ASTF was established as a steering committee to consolidate the processes and results of the individual working groups under its charter. The ASTF originally sanctioned model working groups for each of the affected airplane models; 727, 737-100/-200, 747-100/-200/-300, DC-8, DC-9, DC-10, and L-1011. The Airbus A300 was added to the list of affected airplanes in late-1998. The eight model working groups were comprised of representatives from the airlines, the respective aircraft manufacturer, and the FAA. Neither the DoD nor the other industry associations participated in the inspections, data gathering, or data interpretation. The involvement of these organizations was limited to providing insight to a program that was initiated months before their initial involvement. A minority position of one of the industry members is provided in Appendix G.

Purpose

The purpose of this document is to provide the status of ASTF tasks, summarize the results of the ASTF non-intrusive wiring inspection survey of affected airplane models, provide the results of the ASTF service data review, and summarize the evaluation of repetitive inspection airworthiness directives applicable to the affected airplane models.

The retrieval, compilation and review of individual airline and manufacturer best practices resulted in the Air Transport Association's Specification 117 – Wiring Maintenance Practices/Guidelines. Copies of this specification may be obtained by accessing the following site:

http://www.air-transport.org/public/publications/58.asp

The long-term maintenance program review to account for problems with aging wiring is being accomplished by ATSRAC Subcommittee 2 – Improvement of Maintenance Criteria.

The review of airworthiness directives specifying repetitive inspections of systems components on the affected airplane is described in Part III of this document with results provided in Appendix H

Part I - Non-Intrusive Inspections

Each model working group was tasked with establishing, conducting and summarizing results of a non-intrusive inspection of the wiring of a representative sample of one affected airplane model. The intent of the survey of a portion of the fleet using non-intrusive methods was to assess the overall condition of the fleet with regard to wiring, and to identify any airplane model-unique areas of concern. Each model working group was to determine, zone-by-zone or by another logical sequence, an exhaustive list of potential or unforeseen problem areas, by paying particular attention to:

❶ Wiring, connectors, grounds, circuit breakers, conduits, terminations, etc and its associated hardware in the following areas[1]:

- Flight critical areas.
- Areas normally hidden from view.
- Areas in close proximity to flammable liquids and gases (fuel vapors, oxygen etc.).
- High electric current draw areas.

(Other than wiring effects, the effects on components for pneumatics, hydraulics, flight control systems, etc., as well as engines and fuel systems were excluded for reasons of priority or the fact that these systems were being addressed under other rulemaking advisory programs.)

❷ Aging caused by:

- High vibration
- Harsh environments
- Corrosion
- High maintenance traffic

Each model working group member was tasked with obtaining and sharing past service findings and inspection results to identify additional potential areas for non-intrusive inspection. The model working group OEM members were to also share issues raised by past Service Information Letters, All Operator Letters, and other service information.

Once these non-intrusive inspection areas were defined, an assessment of the safety sensitivity of the affected areas using logic similar to the MSG-3 flowchart logic (safety categories 5 (i.e., evident safety) and 8 (i.e., hidden safety)) was normally conducted to concentrate the inspections on the significant areas.

[1] For the purposes of this report, and unless specified otherwise, the term wiring will be used to indicate the installation of wires, connectors, clamps, contacts, tie wraps, etc. The term wiring does not refer to individual electrical system components, conduits, or circuit protective devices, examination of which was determined by ASTF to be outside of the scope of this program due to schedule, accessibility, and examination constraints.

When the final non-intrusive inspection areas were identified, the working groups were to develop detailed inspection instructions that could be easily understood by all inspectors. Specific reporting forms outlining typical observations were to be used for ease of data compilation.

Included in the inspection document for each airplane model were to be details regarding the aircraft undergoing inspection as well as instructions for actions to be taken if discrepancies were found during inspections.

A sample size of 10-20 aircraft per fleet type was targeted for inspection prior to June 1, 1999. Aircraft from as many airlines as possible, including those not on the working group, and representing the entire fleet were to be included in the survey. Domestic airplanes greater than 20 years old were to be the target of the survey. The late addition of the A300 to the non-intrusive survey, and the fact that very few A300 airplanes were being operated domestically, excluded the A300 from this airplane age requirement.

Airplane Inspection Document Development

The following process outlines the typical working group procedures followed in developing the non-intrusive inspection documents:

❶ WG members performed an initial on-aircraft evaluation of problem areas. Problem areas considered by maintenance and inspection personnel to be high non-routine maintenance activity areas (lots of problems/fixes) were identified by zone.

❷ WG members reviewed high current systems (> or = 15A) based on potential adverse affects of failure on surrounding structure and systems. Failure of any one system to perform its intended function due to degradation of it's own wiring was not considered. This assessment was accomplished as part of an original system safety analysis.

❸ Wiring routing of high current systems was obtained from the applicable wiring diagram manual (WDM) and from on-aircraft validation. This information was tabulated in zonal format.

❹ The wiring inspection was designed to address each zone containing high current system wiring. Fuel tank zones were excluded per Fuel Systems Safety Assessment agreement, i.e., another industry/FAA effort is already addressing these areas. In addition, any zone identified in the original on-aircraft evaluation as having significant non-routine activity was added if not already included in the high current system analysis.

❺ The wiring inspections were written to be detailed visual examinations of all wiring in specified zones.

Inspection instructions for these non-intrusive inspections were drawn from ATA Specification 117, Wiring Maintenance Practices/Guidelines. The inspection was designed to provide detailed discrepancy descriptions while using a tabulated reporting format developed by the ASTF. The inspection documents were included as appendices in the final report from each working group. Although the working group members conducted some inspections, the majority of inspections were conducted using airline maintenance personnel trained by the working groups in the use of the wiring inspection document. Although a formal training program was not conducted, individuals conducting the inspections were normally familiarized with the content of ATA Specification 117, including aspects of FAA Advisory Circular 43-13-1B.

Sample Fleet

The following is a summary of the sampling size for each affected model:

727	9 of 660 active domestic* airplanes 26744 to 72661 hours, 20502 to 59749 cycles	1.3%
737	9 of 1125 active domestic* airplanes 50500 to 68300 hours, 25400 to 72700 cycles	0.9%
747	7 of 203 active domestic* airplanes 57784 to 81965 hours, 8633 to 19363 cycles	3.4%
DC-8	14 of 133 active domestic* airplanes 70200 to 71800 hours, 23900 to 46900 cycles	10.5%
DC-9	15 of 450 active domestic* airplanes 31600 to 87000 hours, 36133 to 91800 cycles	3.3%
DC-10	14 of 212 active domestic* airplanes 32700 to 82400 hours, 9600 to 30400 cycles	6.6%
L-1011	3 of 48 active domestic* airplanes 59231 to 72699 hours, 14567 to 27874 cycles	6.2%
A300	10 of 242 total worldwide airplanes inspected 21000 to 42700 hours, 15900 to 31000 cycles	4.1%

*Domestic fleet data provided by the Air Transport Association

Detailed information regarding the specific results from each airplane inspection is contained in the individual working group reports for each model.

Survey Accomplishment Observations

The number, location, and availability of targeted survey airplanes, and the configuration differences between those airplanes may have resulted in multiple inspection teams, or changes to a particular inspection team. Differences in the expertise, experience, and size of the inspection team's composition may have resulted in different inspection durations/manhours between airplanes and between airplane models. The number of airplane zones targeted and inspected, as well as the size of the airplane, are significant influences in the amount of time spent inspecting each airplane. Estimates are that between 12 and 67 manhours were spent conducting the inspection on each airplane model.

The total number of items noted during each airplane inspection is highly dependent on the number of zones inspected, the total number of airplanes inspected, and at which point during the heavy maintenance visit the electrical inspection was conducted. Some electrical system inspections were conducted prior to the airline's heavy maintenance visit receival inspection. Other inspections were conducted during or after this initial inspection was accomplished and the findings were incremental to other inspection findings.

Survey Results Evaluation Method

Every documented discrepancy from the inspected airplanes was individually evaluated for significance by the applicable model working groups. For evaluation purposes, each item was grouped using the following criteria:

<u>Immediate Fleetwide Safety of Flight Concern</u>
A discrepancy or safety of flight concern requiring immediate fleet action. Impending critical failure seen in the sample.

<u>Potential Hazard or Frequently Occurring (Significant) Item</u>
A defect, which may require design changes or notification for enhanced inspection, based on:

- potential hazard (e.g. fire, bundle damage, essential system damage), or
- frequency of occurrence at a specific location

Note: Though no other signs of degradation may have been apparent, all fluid/chemical contamination findings were typically grouped under this heading due to the unknown long term deterioration effects. An exception to this would be degradation that would obviously pose no hazard.

<u>Defects Noted</u>
A minor discrepancy not requiring any fleet action. Isolated repair seen in the sample.

Evaluation Results

The following is a summary of the items, by group, for each of the affected airplane models. A matrix of this and related survey information is contained in Appendix E.

727 — 276 total individual items noted during the inspection of nine airplanes. None were safety of flight concerns, however, for reasons of repeat occurrences in the same general area or potential hazard sixty-two items were deemed significant requiring additional engineering analysis.

737 — 399 total individual items noted during the inspection of nine airplanes. None were safety of flight concerns, however, for reasons of repeat occurrences in the same general area or potential hazard three items were deemed significant requiring additional engineering analysis.

747 — 238 total individual items noted during the inspection of seven airplanes. None were safety of flight concerns, however, for reasons of repeat occurrences in the same general area or potential hazard three items were deemed significant requiring additional engineering analysis.

DC-8 — 974 total individual items noted during the inspection of fourteen airplanes. None were safety of flight concerns, however, for reasons of repeat occurrences in the same general area or potential hazard ten items were deemed significant requiring additional engineering analysis.

DC-9 — 116 total individual items noted during the inspection of fifteen airplanes. None were safety of flight concerns, however, for reasons of repeat occurrences in the same general area or potential hazard ten items were deemed significant requiring additional engineering analysis.

DC-10 — 714 total individual items noted during the inspection of fourteen airplanes. None were safety of flight concerns, however, for reasons of repeat occurrences in the same general area or potential hazard sixty-two items were deemed significant requiring additional engineering analysis.

L-1011 — 247 total individual items noted during the inspection of three airplanes. None were safety of flight concerns, however, for reasons of repeat occurrences in the same general area or potential hazard twenty-seven items were deemed significant requiring additional engineering analysis.

A300 — 408 total individual items noted during the inspection of ten airplanes. None were safety of flight concerns, however, for reasons of repeat

occurrences in the same general area or potential hazard five were deemed significant requiring additional engineering analysis,

By nature of the detailed visual examination, these results may have varied from inspector to inspector, hence emphasis was placed on the consistency of the inspection crew for each individual airplane model, and on the inspection format. Since a similar inspection crew could not be used on all airplane models, variations may exist between models. All individual items noted during the inspection were addressed through normal operator maintenance practices prior to returning the airplane to revenue service. Those individual items that did not require additional engineering analysis were considered to be unique items requiring no further fleet action. Initial inspection reporting forms did not require recording the type of wiring being inspected but, as directed by ATSRAC, a location to include this information was added to the significant item report if wire type was determined by either the inspector or the working group to be of significance.

Non-intrusive Survey Results and Conclusions

There are no wiring safety of flight concerns identified that would require immediate action on any of the inspected airplanes.

The majority of observed wiring installation discrepancies were found to be in areas of frequent maintenance activity, or related to housekeeping. Fluid contamination, and dust and dirt accumulations were seen on most airplanes. Overall, wiring installations on all aircraft were found in good condition showing little or no evidence of deterioration, particularly those installations undisturbed since manufacture. The working groups did not note any direct correlation between the condition of the wire and actual time in service.

Hardware – Review of the over three thousand individual discrepancies found during the survey led each working group independently to conclude that none appeared to be wire-type dependent. Existing and original wire types were found with degradation such as insulation breakdown and cracking. It is the consensus of the working groups that most or all of the deteriorated wire conditions were in environments not protected from environmental and/or accidental damage. Time in service and the systems that they service seemed to have no appreciable bearing on the condition of the wiring. Areas and zones that are subject to a high level of maintenance activity display more disturbances to the wiring installation than those areas not regularly frequented by maintenance personnel. Items such as improper clamp sizing, inadequate clearance to structure and accumulation of dust or debris were common.

Maintenance - Existing maintenance programs may benefit from providing additional wiring inspection detail. Existing inspection training programs and current GVI criteria should be enhanced to improve detection of wiring installation degradation especially in unprotected areas. These programs should also be enhanced in the area of wiring maintenance practices, for example, protection of wiring from debris or

fluid/chemical contamination. There appears to be some lack of understanding and appreciation for the impact of wiring installation techniques on the durability of that installation and on the reliability of related systems.

Non-Intrusive Inspection Recommendations

It is the recommendation of the ASTF that the following actions be accomplished as a result of the airplane inspections conducted in response to ATSRAC Tasks 1.1 through 1.4:

1. The airplane manufacturers should evaluate using the processes outlined in Appendix C all significant inspection items for appropriate additional action including but not limited to design changes, enhanced inspection procedures, accelerated inspection intervals, etc. Results should be validated by the applicable airplane working groups prior to transmittal to ATSRAC. OEMs should also communicate pertinent data to affected operators.

Update: The OEMs and representatives of participating airlines, the applicable OEM and the FAA which comprise the airplane model working groups have completed this recommended action. Results of the evaluation are provided in Appendix C.

2. Consider the content of each non-intrusive evaluation document in order to identify typical enhancements that will need to be implemented in existing maintenance programs.

3. Consider the content of ATA Specification 117, Wiring Maintenance Practices/Guidelines to enhance the awareness of wiring issues (i.e., inspection, installation, cleanliness, maintenance and repair.

4. Identify appropriate logic to develop specific inspection tasks to permit enhancement of maintenance program documents or upgrade to MSG-3 GVI criteria. Also review appropriate intervals.

5. Enhance standard practices by identifying recommendations that may be implemented in an individual airline foreign object damage (FOD) program to preclude debris contamination inside the aircraft during maintenance or modifications. Implement a ‘clean as you go’ philosophy.

6. Incorporate into aircraft maintenance documentation additional cautions and procedures aimed at preventing accidental damage and/or contamination of wiring installations.

7. Review the above recommendations following the completion of the intrusive wiring inspection program for possible changes and/or amendments.

8. Determine requirement for and implement improved reporting for wiring service history through enhanced ATA chapter organization.

Part II - Service Data Review

Review Methods

The airplane manufacturers conducted a keyword search of pertinent documents (service bulletins, service letters, in-service activity reports, maintenance tips, configuration change support datasheets, and all-operator telexes) using the following keywords provided by the ATA and NTSB.

Arc, arced, arcing, arcs
black, blackened
burn, burned, burns, burnt
Burndy
Cannon
chafe, chafed, chafes, chafing
connector
electric
electrical
electronic
fire
flash, flashed
ground
intermittent, intermittently
open
resistance
shield, shielded, shielding, shields,
short, shorted, shorting,
smoke, smoked, smoking
spark, sparked, sparking, sparks
splice
strip
terminal
thermal
track
wire

All systems, including engines and fuel systems, were included in this search. Documents that contained in their titles these key words were then reviewed for deletion of documents obviously unrelated to electrical systems. Omitted documents included items related to flap *track*s (track) and wheat st*arc*h paint removal (arc), as well as customer requested changes to the production design. The resulted reduced lists were then provided to the working groups for categorization using the following criteria:

Category	Criteria
A)	Potential origins for smoke from an uncontained heat source, fire, arcing, sparking, chafing in pressurized areas or, High current draw or, Materials that may propagate a fire in areas of potential ignition sources
B)	Potential origins for smoke from an uncontained heat source, fire, arcing, sparking, chafing in unpressurized areas or, Potential origins for smoke from contained heat source or chafing in pressurized areas or, Low current draw
C)	Events that could produce arcing/sparking during maintenance but not during normal operation. Note: Items associated with possible personnel shock, including flight crew or passenger, were also classified as category C.

D) Not applicable. Further investigation shows that this document is unrelated to airplane wiring.

Boeing conducted a similar service bulletin review on model DC-8, DC-9 and DC-10 airplanes in October, 1998 prior to accomplishment of this task on the remainder of the affected fleet. All service bulletins potentially related to smoke or fire were evaluated and categorized according to the rules without conducting a prior keyword search. Boeing identified nineteen service bulletins as meeting this criterion and these bulletins have been or are being considered for upgrade to alert status.

In addition a keyword search of DC-8 service bulletin titles was also conducted by the DC-8 model working group. Keywords searched were fire, wire, wiring, cable, feeder, clamp, terminal, strip, and connector. No additional service bulletins were identified as potential problems requiring revisit.

Finally, Airbus conducted service data document selection using the keywords provided by the ATA and NTSB. The 124 retrieved documents applicable to the A300 were filtered to eliminate those already covered by an airworthiness directive. This process produced a list of fifty-two documents that were further reviewed for reassessment of failure mode and effect analysis to decide additional appropriate action if necessary. These fifty-two documents were reassessed for criticality keeping in mind the following parameters (listed in order of importance) :

- occurrence of problem during flight
- high current draw
- potential origins for smoke from unprotected heat source, fire, arcing, etc.
- presence of material and/or contaminants that may propagate a fire in areas of potential ignition sources
- consequences of failure combination in a given zone
- loss of essential systems

In all cases, in-service experience and operator feedback on failure occurrences was taken into account.

The final Airbus review resulted in the decision that three service bulletins should be upgraded from recommended to mandatory compliance and that two service bulletins being already covered by a French AD should be covered by an FAA airworthiness directive. The French DGAC, which is the prime authority for Airbus Industrie aircraft has not been directly involved in the in service document review but the DGAC has reviewed the Airbus Industrie report and accepted its conclusions.

Service Data Review Results

The following is a summary of the categories for each affected model:

727	30 Category A 9 Category B 14 Category C 64 Category D
737	56 Category A 11 Category B 4 Category C 105 Category D
747	154 uncategorized
DC-8	4 Category A 1 Category B
DC-9	10 Category A 16 Category B
DC-10	4 Category A 34 Category B
L-1011	46 Category A 4 Category B 10 Category C 83 Category D
A-300	3 Status upgrades 2 Regulatory action recommendations

Service Data Review Recommendations

It is the recommendation of the ASTF that the following action be accomplished as a result of the service data reviews conducted in response to ATSRAC Tasks 2.1 and 2.3:

1. The airplane manufacturers evaluate using the processes as outlined in Appendix D all service history documents categorized as A, B, or C for appropriate additional action. Appropriate action includes, but is not limited to, raising a document to Alert status. Priority should be given to Category A documents first, then B and C respectively. OEMs should also communicate pertinent data to affected operators.

   Update: OEMs accomplished this review for all categories of service documents. The results, as validated by representatives of participating airlines, the applicable OEM and the FAA which comprise the airplane model working groups, are provided in Appendix D to this document.

Part III – Repetitive Inspection Airworthiness Directive Review

Task Statement

Review any airworthiness directives that require repetitive inspections and determine if continued inspections are warranted, or if a terminating action is appropriate.

Review methods

Each airplane model working group developed a list of repetitive inspection airworthiness directives obtained from the records of the lead airline or obtained the FAA representative to the working group. This list was then reduced by selecting only those ADs applicable to airplanes systems, ATA chapters 00 through 49. Factors considered were:

a) Frequency of inspection
b) Possibility of damage or other adverse impact due to frequent inspections
c) Cost (labor & material) of terminating action
d) Downtime for terminating actions
e) Parts availability for terminating action

This listing of systems ADs was then provided to members of each airplane working group with an associated form to be completed by the membership. Items to be evaluated on the form were as follows:

a) Description: Provide a brief description of the airworthiness concern and the required actions.
b) Current Inspection Intervals: List the current inspections and intervals associated with each task
c) Qualifying AD: Ensure that there is a condition on the world fleet of aircraft where the inspection activity required does result in a significant enough frequency (as determined by the working group) of negative findings. Further insure that the AD affects more than 5% of the world's population of aircraft for that fleet.
d) Existing Terminating Action: Determine if there currently exists an effective terminating action. Further insure any terminating action called out in the AD is an effective answer to the airworthiness concern. Use operator, OEM, or FAA data as available to the group to make this determination.
e) Existing Repetitive Inspections Effective: Determine if the current repetitive inspections are an effective method of satisfying the airworthiness concern. Explain why or why not.
f) AD require Improvement: Ensure that the actions called out in the AD are satisfactory in addressing the airworthiness concern. If not, make a note on this item that the AD needs improvement and state why. Do not attempt to develop improvement actions at this point. Only evaluate the AD actions. Also, consider any known AMOCs to the AD that may have been granted as a possible improvement to the AD.

Using a voting process established by the airplane model working group chairman, representatives of participating airlines, the applicable OEM and the FAA which comprise the airplane model working groups determined whether or not the AD should be listed as a candidate for mandated terminating action using the information developed in the above questions. The results from each airplane model working group was then collected by site focals and provided to the ASTF chairman. The evaluation results and recommendations for additional activity are contained in Appendix H to this document.

Repetitive Action AD Review Recommendations

It is the recommendation of the ASTF that the following action be accomplished as a result of the airworthiness directive reviews conducted in response to ATSRAC Task 2.2:

1. The FAA review the eight airworthiness directives contained in Appendix H to this report for consideration of mandating termination of the repetitive actions.

Appendix A
Non-Intrusive Electrical Survey Summary Forms – Example

PTT/CYCLES	AIRCRAFT WIRING INSTALLATION/CONDITION REPORT FORM																																							
	AREA/ZONE																																				PAGE OF					
	CONNECTORS								TERMINATIONS						INSTALLATION (GENERAL)												WIRING CONDITION															
1) ENTER AREA/ZONE BEING EVALUATED IN SPACE PROVIDED. 2) USE SEPARATE FORM FOR EACH AREA/ZONE, USE ADDITIONAL FORMS AS REQUIRED. 3) CHECK CONDITION NOTED, USE "OTHER" FOR ANY CONDITION(S) NOT LISTED. DESCRIBE CONDITION. 4) ENTER SYSTEM OR COMPONENT INFORMATION IF AVAILABLE.	INSERT DAMAGE/DETERIORATION	CONTACT ARCING/FRETTING	MISSING DUMMY CONTACTS/SEAL PLUGS	MISSING/DAMAGED BACKSHELLS	CONNECTOR BACKSHEEL STRAIN RELIEF	LOOSE OR WORN B-NUTS	OTHER		GROUND POINTS - CONDITION/SECRUITY	INADEQUATE DRIP LOOPS(S)	CORRECT HARDWARE BUILDUP/TORQUE	HEAT DAMAGE/CORROSION	OTHER		INADEQUATE CLEARANCE TO STRUCTURE	MISSING/DETERIORATED PRESSURE SEALS	SLEEVING/DONUITS CONDITION	BEND RADIUS (10X WIRE/BUDNLE DIA.)	CLAMP CONDITION/SIZING/SPACING	MISSING/DETERIORATED GROMMETS	DEBRIS ACCUMULATIONS ON WIRE BUNDLES	EXCESSIVE SLACK/SAG BETWEEN CLAMPS	T-STRIP CONDITION/HARDWARE BUILDUP	SIGNIFICANT DUST AND LINT BULDUP	OTHER		PREVIOUS REPAIRS/CONDITION OF	HEAT/VIBRATION DAMAGE	INDIRECT DAMAGE (HYD, PNEU LEAKS)	CRACKED/ABRADED INSULATION	BROKEN SHIELD/CONDUCTORS	EXPOSED CONDUCTORS/SHIELD	FLUID/CHEMICAL CONTAMINATION	CORROSION	OTHER	
AREA/SYS COMPONENT																																							
1.																																							
2.																																							
3.																																							
4.																																							
5.																																							
6.																																							
7.																																							
8.																																							
9.																																							
10.																																							

Appendix A
Non-Intrusive Electrical Survey Summary Forms – Tabulated Results

Aircraft Wiring Installation/Condition Report Summary

NOTE: The enclosed data reflect raw numbers. Comparison between fleet types requires this data to be normalized to account for aircraft in each fleet type, zones inspected and bias induced by each individual work group.	Connectors								Terminations						Installations (General)												Wiring Condition									
	INSERT DAMAGE/DETERIORATION	CONTACT ARCING/FRETTING	MISSING DUMMY CONTACTS/SEAL PLUGS	MISSING/DAMAGED BACKSHELLS	CONNECTOR BACKSHEEL STRAIN RELIEF	LOOSE OR WORN B-NUTS	OTHER		GROUND POINTS - CONDITION/SECRUITY	INADEQUATE DRIP LOOPS(S)	CORRECT HARDWARE BUILDUP/TORQUE	HEAT DAMAGE/CORROSION	OTHER		INADEQUATE CLEARANCE TO STRUCTURE	MISSING/DETERIORATED PRESSURE SEALS	SLEEVING/CONDUITS CONDITION	BEND RADIUS (10X WIRE/BUDNLE DIA.)	CLAP CONDITION/SIZING/SPACING	MISSING/DETERIORATED GROMMETS	DEBRIS ACCUMULATIONS ON WIRE BUNDLE	EXCESSIVE SLACK/SAG BETWEEN CLAMPS	T-STRIP CONDITION/HARDWARE BUILDUP	SIGNIFICANT DUST AND LINT BULDUP	OTHER		PREVIOUS REPAIRS/CONDITION OF	HEAT/VIBRATION DAMAGE	INDIRECT DAMAGE (HYD, PNEU LEAKS)	CRACKED/ABRADED INSULATION	BROKEN SHIELD/CONDUCTORS	EXPOSED CONDUCTORS/SHIELD	FLUID/CHEMICAL CONTAMINATION	CORROSION	OTHER	
A-300	4	1		11	27		5		16			3	1		86		47	5	62	15	12	5	2	2	28		32		11	22		4	6	1		408
DC-8	20		4	10	13		39		41	3	9	11	14		106	3	123	6	160	12	23	87	26	3	18		145	3	2	40	17	13	16	7		974
DC-9							1		14			2	3		6		5		22		18	2	9	27	3		2								2	116
DC-10	17	2	7	22	34	11	27		18	4	4	22	8		53	2	14	16	97	7	53	42	4	84	34		11	6	14	45	13	5	21	8	9	714
B-727	2		6	1	2	1	7			1		1	2		18	1	1		60	5	24	25	4	29	19			3	9	20	9	7	14	3	2	276
B-737	3	1		2	19		7		5	1	2	5	4		59		11	2	52	6	15	59	1	50	11		32	1	2	18	3	3	8	1	16	399
B-747			2	1	2	1	2		1			1	9		16		5	3	13		31	5	1	19	10		18	3	2	18	12	13	29	11	10	238
L-1011	4		4	4	1	3	8		3			3	4		36		4	6	29	5	12	13	1	19	31		5	6	1	9	5	13	10	3	5	247
Total:	50	4	23	51	98	16	96		98	9	15	48	45		380	6	210	38	495	50	188	238	48	233	154		245	22	41	172	59	58	104	34	44	3372

Differences between the values in each category for individual models may be due to differences in the inspection personnel, the total amount of time placed on conducting the inspection, whether the inspections were conducted prior to or following the incoming airline inspection, the number of airplanes in the survey, and the relative age of the airplanes undergoing inspection. Please refer to the report text for additional information on these differences.

Appendix B

Significant Item Reporting Form – Example

Non-Intrusive Inspection
Significant Item Report

Aircraft Involved:

1, 2, 3, 4, 5, 8, 9, 10, 12, 14

Description of Discrepancy:

(Write description here. Include details regarding aircraft system or location in which the discrepancy was found.)

Location; Electrical and Equipment Bay. Dust bunnies accumulated on the shelves and wire bundles. Station 110 – 218.

Was discrepancy found during routine maintenance? If so, what was the maintenance visit?

Yes, during heavy maintenance visit. A/C was brought in to the Hangar and opened up for GVI. DC9 Aging Wiring Inspection Survey was done after the GVI during the check.

Type of wires currently installed discrepant location (e.g. pvc/glass/nylon, specification #).

Mostly original wiring. Some wiring has been added over the years for different and/or new equipment installation. Type used is unknown. Suspect that it is MilW22759 or similar.

Relevant maintenance history (e.g. numerous log book write ups or other problems):

Unknown.

Hypothesis on possible or probable cause for discrepancy.

Lack of vacuuming. Should be done at heavy maintenance before closure of the area. Need to raise awareness of lint and dust as a potential combustion source.

Appendix C

Significant Item Review Process Summary and Results

The OEM evaluation of those items identified during the non-intrusive wiring inspection and deemed significant by the individual model working groups was accomplished using our internal processes for addressing in-service concerns.

Engineers within the OEM Service Engineering or Design offices whose expertise includes wiring installation, operator maintenance programs, standard wiring practices, and substantial experience with the service record of each airplane model conducted an initial study of the significant item in terms of airplane safety, operations, reliability and maintenance. These engineers evaluated the data provided on each of the 182 significant findings using existing techniques which included evaluation of the wiring location, maintenance access, exposure to accidental as well as environmental damage, service experience, and previous modification/inspection recommendations made by the manufacturers.

Step 1

For Boeing, each engineer summarized the evaluation into a conclusion that was then provided to the FAA designated engineering representative responsible for either the wiring installation on the pertinent airplane model, or responsible for the airplane system which the wiring serviced. In each case the DER reviewed and either concurred with or amended the Service Engineering conclusions.

The results of both the SE and DER reviews are provided in the accompanying spreadsheet.

At Airbus the decision was made to require further design input which is now in process.

Step 2

If the Boeing Service Engineering and DER reviews of the particular attributes of the noted item determined that further action may be warranted, these specific items were to be reviewed with the Chief Engineer of the pertinent model and the Model Fleet Chief responsible for maintaining fleet reliability. None of the 150 Boeing items were determined to be issues of airplane or personnel safety, or require additional review beyond that performed in Step 1.

The Airbus review was treated in a similar fashion under the corresponding European process for the 5 significant items detailed in the A300 summary document. The recommended solutions when finalized will pass through the Design

Approval Process under the authority of the DGAC as the prime airworthiness authority. None of the 5 items is considered to be safety of flight related.

None of the findings on the L-1011 were determined to be an airworthiness concern. Lockheed-Martin plans to issue an all operators notice emphasizing the importance of incorporating improved maintenance practices as outlined in Spec 117. Lockheed-Martin will also reiterate the zones in which inspection efforts should be focused

Step 3

Although no items deemed significant by the airplane model working groups warranted further action from that already accomplished by the airlines following the survey, Boeing believes that the information obtained through this survey, review, evaluation and summary process should be provided to all affected operators. Boeing will be releasing an all-operator communication which will outline the results of the survey and highlight modifications or inspections presently available which will prevent future occurrences of the type found during the survey.

Step 4

Results of the OEM evaluations were summarized into the attached spreadsheets and provided to the airplane model working groups for review and concurrence.

BCAGSigItems.xls

"A300 Significant Items.doc"

L1011 Findings.xls

Appendix D

Service Data Review and Response Process Summary and Results

Existing service data documents categorized as A, B or C in the individual airplane model summary reports underwent the following evaluation process at each airframe manufacturer:

Engineers within the OEM Service Engineering or Design offices whose expertise includes wiring installation, operator maintenance programs, standard wiring practices, affected airplane systems, and substantial experience with the service record of each airplane model, conducted an initial study of the service documents. This initial review assessed whether the noted document addressed an airplane wiring or wiring installation concern which could prevent instances of arcing, sparking or wire damage. Each item was reviewed for applicability to airplane wiring, i.e. some documents modified the applicable system for reasons other that to correct a wiring concern. Documents which added or modified airplane systems and which did not specifically address airplane wiring were spared further evaluation. If the document was related to airplane wire specifically, the specification of wire originally used was documented.

Step 1

These engineers conducted a detailed evaluation of each of the wiring-related documents, focusing on the nature of the document recommendation/modification and the background which prompted release of the document. Each resulting evaluation summary includes a recommendation, which may or may not advocate that additional emphasis be placed on fleet incorporation of the recommendations or modifications contained within the document. At Boeing, these summaries with their accompanying recommendations were reviewed by the FAA designated engineering representative responsible for either the wiring installation on the pertinent airplane model or responsible for the airplane system which the wiring serviced. In each case the DER reviewed and either concurred with or amended the Service Engineering conclusions. The results of both reviews are provided in the accompanying spreadsheet as yellow highlights.

The Airbus Industrie review of the 52 relevant documents was carried out in a similar fashion under the corresponding European process.

Step 2

If the Boeing Service Engineering and DER reviews of the particular attributes of the noted item determined that further action may be warranted, these specific items were reviewed with the Chief Engineer of the pertinent model and the

Model Fleet Chief responsible for maintaining fleet reliability. These Engineering Investigation Board (EIB) reviews, which consisted of 519 Boeing documents across the six affected models, was conducted using the FAA-approved continued operational safety process, the same process used to evaluate service items reported to the FAA under FAR 21.3. The recommendation/modification and the background of each document, some of which were released as early as 1974, were evaluated as if they were recent releases, accounting for the recent concern with airplane wiring. Items which have completed this additional Chief Engineer/Fleet Chief review, and which have been determined to warrant further action, are highlighted in the attached spreadsheet as blue highlights.

At Airbus a similar evaluation occurred but the conclusions of the review detailed in the attachment were presented to the French DGAC which is the prime airworthiness authority for Airbus A/C.

Step 3

Boeing documents which have been selected to be released as alert service bulletins will undergo further review by the Boeing Safety Review Board, a process which includes FAA representation. Should an item be identified as affecting airplane or personnel safety, and release of an alert service bulletin deemed appropriate, Boeing will be contacting the appropriate lead airline per procedures provided by ATA Specification 111, Airworthiness Concern Coordination Process to alert them to the forthcoming release.

Airbus has identified 3 service bulletins which will revised from recommended to mandatory. Airbus has notified affected operators of the imminent release of these documents and will update that notification in October 2000 with any additional recommendations.

If not already designated on the attached spreadsheet, a determination regarding the safety aspects of the Boeing significant items and the form any further action will take will be available by late-September 2000.

Step 4

Results of the OEM evaluations were summarized into the attached spreadsheets and provided to the airplane model working groups for review and concurrence.

BCAGServDocuments.xls

"A300 Service Document Review.do

Lockheed and the L1011 Working Group reviewed 53 service documents for possible upgrade or other action. None were found to warrant further action.

As of July 20, 2000, a decision has been made to Upgrade the following documents to "Alert" status. Others documents will be added to this list as studies are completed.

Model	Document	Title
A300	SB 24-0053	Chafing/Short Circuits in Wing L/E - Pylon Area
A300	SB 24-0079	Arcing/Burning at the APU Starter Feed Line Terminal
A300	SB 24-0083	Chafing/Short Circuits in Wing L/E - Pylon Interface Zones
DC-8	SB 24A068	Electrical Load Distribution - Toilet Flush Circuit Breakers
DC-8	SB 30A032	Windows and Windshields - Replace Window Wiring Conduit
DC-8	SB 33A053	Passenger Compartments - Install Protection Insulation on Terminals of Cabin Lighting
DC-9	SB 24A072	Electrical Load Distribution - Revise APU Power Feeder Bus
DC-9	SB 24A115	Electrical Load Distribution - Install Grommet on Power Center Conduit
DC-9	SB 24A135	External Power - Replace Ground Stud and Install Nameplate
DC-9	SB 33A037	Passenger Compartments - Install insulation Banket Supports and Rework Reflector
DC-9	SB 33A058	Passenger Compartments - Revise Wire Routing of Attendent's Aft Cabin Work Light
DC-9	SB 33A062	Lights - Passenger Compartments - Revise Cabin Sidewall Lights Circuitry
DC-9	SB 33-081	Lights-Cargo/Service Compartments-Modify Light Switch (11/8/2000)
DC-9	SB 33A111	Passenger Compartment - Replace Upper and Lower Cabin Sidewall Fluorescent Light
DC-9	SB 74A001	Ignition - Switching - Replace Rotary Ignition Switch
DC-10	SB 24A143	DC Generation - Relocate Battery 1 Ground Stud Bracket Assy (12/31/2000)
DC-10	SB 24A147	Electrical Load Distribution - Install Spiral Wrap on External Ground Power Feeder
DC-10	SB 24A149	General Modify Wire Bundle Support Clamp Installation at Flight Engineer's Station
DC-10	SB 76A048	Autothrottle - Replace Anti-Chafe Sleeving on Throttle Control Module Wiring (TBD)
747	SB 24A2118	P4 Panel Wire Chafing
747	SB 25A2407	Flight Engineers Panel Wire Bundle Clamping and Mod
747	SB 35A2035	Passenger Oxygen System Inspection

Appendix E – Non-intrusive Wiring Survey Summary

Findings Summary								
A/C Type	DC8	DC9	DC10	727	737	747	A300	L1011
No. of A/C Inspected	14	15	14	9	9	7	10	3
Age Range	29-31	20-32	12-27	17-33	18-22	15-24	10-17	18-26
Immediate Fleetwide Safety	0	0	0	0	0	0	0	0
Significant Items	10	10	62	62	3	3	5	27
Total Items	974	116	714	276	399	238	408	247
Items Per A/C	70	8	51	31	26	34	42	83
Avg Manhour per a/c	N/A	8 per SB	67 actual	40 per SB	40 per SB	Not Avail	Not Avail	40 per SB
Inspection By:	Insp	Mech	Mech	Mech	Insp	WG	OEM Eng'r	WG or Mech
Inspection Location:	hmv	hmv	hmv	hmv	hmv	hmv	hmv or p-f	retired or hmv
Possible S/B Upgrades*	See Appendix D	See Appendix D	See Appendix D	See Appendix D	See Appendix D	See Appendix D	See Appendix D	See Appendix D
		p - f - passenger to frt'r conversion						

Appendix F - Aging Systems Task Force Voting Members

Name	Company
AIRLINE	
Doug Drummond	Canadian Airlines
Gary Martin	America West
Johan Muller	American Trans Air
Kirk Thornburg	Northwest Airlines
Norman White	US Airways
Randy Harris	American Airlines
Randy Pope	FedEx
Steve Cunningham	Continental Airline
Tim Herndon	Delta Airlines
ATA/IATA	
Norman Vincent	IATA
Rick Anderson	ATA
DOD	
David Johnson	USAF
Pall Arnason	NAVAir (U.S. Navy)
REGULATORY	
Chris Smith	FAA
George LeBlanc	Transport Canada
WORKING GROUP LEADERS	
Chris Frissora	FedEx
Daniel P. Boggs	DHL Airways
Hank Zuberer	United Airlines
Larry Stevick	Northwest Airlines
Mark Meeker	UPS
Prewitt Reaves	Southwest Airlines
Rene Savoie	Airbus industries
Rob Lyon	Delta Airlines
INDUSTRY	
Dave Allen	SAE
Edward B. Block	Consultant/NADA
OEM	
Don Andersen	Boeing
Denis Kearney	Lockheed Martin
Colin Kane	Airbus Industries
Paul Buron	Boeing DPD

Appendix G – Minority Position

Introduction

The attached letter was received from Mr. Edward B. Block on January 25, 2000. This was soon after the first draft of this report was presented at the ATSRAC meeting on January 19-20, 2000. During the ASTF meeting on February 2, 2000, Mr. Block was asked if he would like to revise this letter based on new information. He declined. The numerous changes in the March 14, 2000 version of this report are based on requests from the ATSRAC on Jan. 19-20, written inputs from various ASTF members and the work of the ASTF "writing group". Mr. Block declined to change the Jan. 25 letter after these numerous changes. It is published as a "Minority Position".

Aging Systems Task Force March 14, 2000

Chairman, ASTF 1-25-2000
Mr. Randy Pope
Federal Express

Dear Mr. Pope,

In regard to the Summary Report dated 11 Jan 2000, that was submitted to the ATSRAC, designated as "ASTF, Aging Transport Systems Task 1 and Task 2, Final Report", the following is submitted and is to be considered as a dissenting opinion. It is requested that these objections be included with any further submissions to the ATSRAC.

1. The issue of including wire type was voted on and agreed to by ATSRAC on 1-20-1999.
2. There was a subsequent vote taken by ATA the next day, to rescind this ATSRAC vote, and to only cite wire type when problems were found. This was done on 1-21-1999.
3. There was a presentation given on 3-31-1999 by Edward Block to the ASTF Meeting on "Why Wire Type Matters."
4. At the subsequent ASTF Meeting in June 1999, it was stated by Boeing that they had been interviewed for twelve hours by the BBC Panorama Show. It was further stated that Edward Block was right, that wire type did matter, and that it was going to affect every member of the ASTF.
5. At the same meeting in June 1999 of the ASTF, each Working Group Chairman gave a status of their model inspections. As each reported problems, Edward Block asked what type of wire was used? The answer was: we don't know. This was in violation of the two previous votes taken by ATSRAC and the ATA respectively about identifying wire types.
6. The Edward Block Addendum was added to the ATSRAC Minutes for the July 1999 Meeting, specifically recording these events.
7. There was no consistency in the Working Groups in regard to establishing how much time would be involved in the model inspections.
8. There was no consistency in the details of how to inspect, i.e. arms length, flashlights, mirrors, etc..
9. The reporting form that was used, did not even include a place to record wire type.
10. The definition of what constituted 'Significant' findings, wasn't even decided until after the inspections were over.(SEPT 99)
11. The supposed re-depositing of information, (where wire type wasn't initially recorded), to the new significant finding form, which now included (after Sept.1999) wire "type", cannot be considered at all conclusive.
12. There can be no reliance on this summary report's findings, when Task Group Members never saw the results of either the inspections or the service data reviews.

13. The Specification 117 being heralded, does not include any reference to wire types.(i.e. mixing wire types warned against by AC 25-16)
14. The issue of repetitive inspections for AD's was never discussed with the full membership of ASTF.
15. Page 4, third paragraph from the bottom, states that the term wiring does not refer to individual electrical system components (wiring?), but as stated in the preceding sentence: the installation of wires. This would mean that nothing refers to the **insulation** material of the wiring. This is saying we only looked at installation and not insulation.
16. I had personally battled to be on these two Task Groups (1 & 2), and had to force the issue of my presentation on "Why Wire Type Matters." I was then kept from inspecting or reviewing any aircraft or service data.
17. Each Working Group *subjectively* decided on inspection levels, methods, and the time to accomplish it.
18. Page 5, paragraph 6, "Failure of any one system to perform its intended function due to degradation of its own wiring was not considered." This statement dismisses the explosive nature of certain insulations to effect nearby bundles. This lack of appreciation for bundle separation negates recent NTSB/TSB findings as well as FAA laboratory results.
19. The majority of the inspections weren't conducted by ASTF members, but rather airline personnel. (Page 6, paragraph 2)
20. 81 aircraft of approximately 14,000 were inspected.
21. The fact that 144 items (discrepancies) were deemed ***significant*** (potential hazards) out of only 81 aircraft inspected is in fact, significant.
22. The definition of significant was applied subjectively and retroactively, after the fact. This is because the very definition of significant wasn't even decided until after the inspections were done.(Sept 99)
23. After looking at only 81 aircraft, 3,224 discrepancies were found. This is significant.
24. Page 8, sixth paragraph, the subjective nature of this whole summary is expressed.
25. Page 9, wiring installation referred to rather than 3,224 discrepancies found.
26. Page 9, paragraph one, last sentence – the statement that there is no direct correlation between the condition of the wire and actual time in service, is overstated. No hours were even recorded for individual aircraft until after September 1999. This correlation would have to be considered at best, a subjective look back, by people who didn't even inspect the aircraft.
27. Page 9, paragraph 2, sentence 1: How could wire type be decided upon, if it wasn't even recorded until after September 1999? This whole paragraph is a subjective, non-data driven evaluation, meant to devalue the meaning of wire type.
28. Page 9, paragraph 1, sentence 2: the fact that in 1991, the FAA developed Handbook 91-15 Inspection of wire bundles for dirt and lint should be addressed here. If sufficient inspection criteria was developed by PMI's in 1991, why were dust and dirt accumulations seen on most aircraft? Has anyone seen this Handbook?

29. Page 9, Non Intrusive Inspection Recommendations, The ASTF membership should have seen the results of their work.
30. Page 11, Part II – Service Data Review; there is no mention of the meager initial word search, prior to the NTSB recommending this greatly expanded 40-word search base.
31. Page 12, 19 Boeing Service Bulletins updated to alert status, this is **significant**, what were they?
32. Airbus updating of three Service Bulletins to go from recommended to mandatory compliance; 2 Service Bulletins should be airworthiness directives, this is **significant**.
33. 175 documents were found (Category A & B) to be potential origins for smoke from an uncontained heat source, fire, arcing, sparking, chafing in pressurized or un-pressurized areas, this is **significant**.
34. Page 13, numerous empty (?) are not at all conclusive.
35. The documents; significant findings, and service Data Review items deemed A ,B, or C should be given to all ASTF members and then to the ASTRAC. How can they make data-driven decisions without data.
36. The actual formation of the Intrusive Inspection Group was based on the persistence of Edward Block to cite wire types, and to address the shortcomings/limitations of each type of wire.

In conclusion, this summary report is seriously flawed. It misrepresents the evolution of events in regard to wire type identification, and then misstates unrecorded findings into supposedly conclusive remarks regarding wire type. Generally the fact that most ASTF members didn't participate in the inspections or in the review of the Service Data, should preclude addressing this document as an ASTF document. We didn't see the aircraft and we didn't see the service data. This document further paints a picture that no problems were found when 3,224 items were in fact found. 144 of these were found to be significant, of course this was after the fact. 175 documents were deemed to relate to potential origin for smoke, fire, arcing, sparking, and chafing in pressurized or un-pressurized areas. These are significant findings and have indeed resulted in the formation of an Intrusive Inspection Committee to look further. To dismiss these findings, without a detailed review by either the ASTF or ATSRAC is simply misleading. I object to the fact that I have been indicated as participating in these findings and want the record and any subsequent submission to ATSRAC, to reflect these objections listed here.

Sincerely,

Edward B. Block
ASTF Member

Appendix H

"Repetitive ADs.xls"